

RRCC Science Expo

Spring 2017 Program

Wednesday, April 26, 10am – 12pm

Current, Electromagnetism, and Railgun Efficiency

David Peck, Stephen Albert, Tara Braden, Garrett Hoiness, PHY 212 Advisor: S Spivey

Railguns are projectile launching devices that use large amounts of current to accelerate a projectile to a high rate of speed in a short amount of time. We sought to design a small scale railgun in order to experiment and further understand electromagnetic forces and their efficiency in this system, as well as to design a working apparatus for consistent launching of a projectile. We were able to achieve 50% consistency with our apparatus design, but the ability to achieve large amounts of power and projectile velocity was outside the scope of our budget and machining capabilities; and our energy efficiency was extremely low. However, our circuit design worked exceedingly well, and we are confident that based off our data and observations we could make many improvements to the launching apparatus if we were to design another device.

Coil Gun

Lexi Walz, Shelby Ryan, Mike Villao, Agustin Aguilera, PHY 212 Advisor: S Spivey

The purpose of creating a coil gun is to gain an understanding of the physics behind electromagnetic fields. The “gun” is comprised of coil wire to function as an electromagnet which works as a motor to discharge a projectile. In order to gain an understanding of the electromagnetic fields, our team will enhance the accuracy of our gun to ultimately hit a target with a degree of accuracy. To achieve this, we will vary the current supplied to the gun, the gauge of the wire as well as the number of windings to determine how this affects the accuracy and muzzle velocity. In addition, our team is interested in seeing how different voltages applied to each coil affects the magnetic field. Also, whether we can increase the magnetic field by vary the number of windings to lead to a more powerful projectile.

Modular Rovers

Shelby Ryan, Forrest Havermann, Christian Prather, Lydia Rice and Chris Biringer, NASA Space Grant Advisors: B Sobhani, J Beard, S Spivey, B English

Current development of rovers and autonomous programs have been in large slow and costly. Obtaining required hardware, materials and the development of software takes a large amount of resources and time. There is a promising solution to the cumbersome design process in terms of low cost and relatively easy to use microprocessors such as Arduino. These have become relatively cheap and accessible to everyone. With all the resources supporting the Arduino community, schools are now able to provide their students greater opportunities for innovation and experimentation. Projects such as rover design can inspire and expose younger students to the problems that exist in the real world of design and engineering, all with relatively simple coding and hardware hookup. If successful we will have created a rover that younger generations can build and learn from, ultimately preparing creators and innovators to better tackle issues concerning autonomous space exploration in years to come.

A Study on Growth of *Brassica oleracea* (Acephala group) and Crop Production of *Zea mays* in Aquaponic Mediums

Goran Shikak, Jeremy Ansah-Twum, Sarah Kidder, Alex Mayberry, Soren Frederiksen, BIO 112 Advisor: S Kaye

Our experiment aimed to display and determine the best possible growing environment for or *Brassica oleracea* (Acephala group) Premier blend kale while also observing the effects of using a rock/lava bed to enhance the growth of Bloody Butcher cultivare of corn, or *Zea mays* as compared to traditional agricultural methods. Originally, our team intended to cross breed the *Brassica oleracea* (Acephala group), however due to time constraints we had to simplify the experiment and restructure our hypothesis around the success and growth rate of each crop in the various media. We germinated the kale then transplanted into the rock and floating beds to observe a potential increase in growth rates. The same was done concerning *Zea mays* and the rock bed, but none were planted in the floating beds. For 6.5 weeks, members of our team measured and recorded the plant growth in each conducive environment. After taking the final measurements overall growth was compared between the rock and floating beds to determine which one was the best for growing *Brassica oleracea* in an aquaponics system. Our results show that on average the kale in the rock bed performed and grew better than kale in the floating bed. Furthermore, all corn and kale crops planted in the aquaponics rock bed system were successful and experienced faster growth rates when compared to the literature values presented for the average growth of corn and kale crops in traditional agriculture. This was consistent with our initial prediction and helped validate our hypothesis.

Domesticated Animals and Their Effect on Bacterium Growth

Garrett Curtiss, BIO 111 Advisor: T Gray

Do dwellings with domesticated animals have an impact on the amount of bacteria that accumulates on carpet? In this experiment our purpose was to determine the effect cats and dogs have on bacteria in a residential home. Our method to test the bacterium growth was to use a sterile cotton swab to collect a sample from carpeted flooring, and then use the streaking method to isolate colonies of bacterium growth. We analyzed our data by measuring the surface area of bacterium growth on the agar dishes and comparing the collected data of homes with and without domesticated animals. Our results show that having animals has a significant effect on the amount of bacteria that resides in carpeted flooring. Homes with cats created the greatest amount of bacteria, 85% of the surface area was covered, compared to homes with only dogs, averaging at 58%. The two control homes in this experienced averaged a mere 10% of bacterium growth on the agar dishes. Many variables that were not controlled could have led to the wide range of results such as the temperature of the homes, lighting, amount of foot traffic, and age of carpet. However, from the results of our data indicate that indeed domesticated animals will increase the amount of bacteria found in homes.

Lavender Essential Oil's Effect on Daily General Anxiety

Matilda Shearer, BIO 111 Advisor: T Gray

In order to answer our question, our team had to determine which was the best route for measuring anxiety in the individual. After thorough research, we decided that administering an anxiety test was the best option for measuring the anxiety levels of each subject. We gave out samples, which were cotton rounds in plastic baggies with 10 drops of lavender each. We gave out 8 samples each, giving us a sample size of 32.

Comparative Growth Between *Brassica oleracea* and *Cichorium endiva* within an Artificial Aquaponics System Water Bed Versus Artificial Aquaponics Lava Rock Bed

Courtney McCreery, Sierra Knodle, Mirian Mendez, Joanne Change, BIO 112 Advisor: S Kaye

This experiment was conducted to observe and interpret the benefits of sustainable growth within an artificial aquaponics system in the greenhouse at Red Rocks Community College. The comparative analysis involved two species of plants *Brassica oleracea* and *Cichorium endive*, more commonly known as dinosaur kale and endive, in addition to the comparative analysis of two different growing mediums in the aquaponics system: a floating water bed and a lava rock bed. For a duration of six weeks the height of the plants was measured twice a week and the condition of the plants overall health was observed. In the end, our hypothesis was partially supported by both plants growing better in the floating water bed. However, when the weight of the plants was measured at the end of the six weeks the endive produced a higher amount of vegetation than the kale in both mediums.

The Effect Of Color Film On Lemon Basil Growth

Sana Xiong, Lynzee Allen, Jacob Trelease, Jamie Rush, BIO 112 Advisor: S Kaye

The following experiment was done to test out the effect color filter has on lemon basil growth height over a period of six weeks in an aquaponic environment. This experiment included lemon basil as the main crop, and color filter blue, yellow and green. In the experiment 12 basil plants were tested, three for each color filter and three for control. It was hypothesized that the green filter would negatively impact the growth height of lemon basil, the most, out of all three colors including the control group. In conclusion, the hypothesis was not supported. The green color filter group was actually the most successful group in height growth.

The effect of glucose and fructose on *Brassica rapa*

Anna Bergstrom, Erika White, Emma Meis, BIO 111 Advisor: T Gray

Our experiment tested the effect of glucose and fructose on the growth rate of *Brassica rapa*, or Wisconsin Fast plants. Groups of *Brassica rapa* were watered with solutions containing 4g/L fructose, 40g/L fructose, 4g/L glucose, 40g/L glucose, 2g/L fructose & glucose, and a control group of distilled water. None of the treated groups grew significantly taller than the group watered with only distilled water, and the 40g/L fructose group was shorter in average height, and had shorter and narrower leaves than the control group. The high concentration of fructose may have inhibited water uptake. The fructose also attracted mold, possibly impeding plant growth.

Does Music Effect Fish?

Makala, Airyanna, Isiac, Walker, BIO 111 Advisor: T Gray

Abstract: The effect of music genres on fish activity was an interesting topic for our group to research. We've learned that other animals like elephants reacted to musical instruments in a positive way so we decided to test it out on fish to see if they would have the same reaction. We gathered 10 fish into one tank and we placed a speaker by the tank exposing the fish to 9 different genres of music. Reggae, rock, rock and roll, hip hop, folk, rap, country, classic rock, and metal. We measured the activity level on a scale of 1-10. Normal Activity was the fish hanging out in the bottom of the tank towards the back. As we performed the experiment the genre that showed the least amount of activity was reggae the activity level was 1 and the highest level of activity was rap the activity level being a 7. Leaving folk at a 2, classic rock at a 3, rock and roll a 3, metal a 4, rock a 4, country a 5, and hip hop a 6. Looking at the activity levels the

fish didn't really react a whole lot to the slower more calm music this being because it isn't as loud as the other genres. The fish could've reacted more to the louder more upbeat music because they were scared. If this experiment were to be tested again I would recommend leaving each genre by the tank for a few days instead of one day because that could show more effective results and also increasing the amount of fish.

Eyewitness Testimony Against Period of Time

Abbie Greene, Joey Cronin, Amanda Kinsey, Megan Kirsten, BIO 111 Advisor: T Gray

This study examined the effect of time on memory. The class experienced a stressful situation of a student getting arrested during a normal routine. After minutes the action that took place, the class was asked to take a survey and see how well they remember the encounter. The class was then asked to take the survey a week after the situation and two weeks after the situation.

Average Growth of Tea Plants in Aquaponics v. Traditional Environments

Ethan Larrimore, Tristan Strayer, Fayelynn Scheideman, Vu Tran, BIO 112 Advisor: S Kaye

Runoff. Pollution. Eutrophication. False phosphates. Pesticides. Wasted water. Traditional agriculture does nothing but decimate these lands. There must be another way, one that replicates nature in itself: aquaponics. This natural process allows for crop to be grown without the potential environmental destruction caused by runoff of farmer-added nutrients and allows for the crop to be grown with up to 90% less water than it would require for traditional agriculture. This is all magnificent from the start, but what about the rate of growth? Could the same type of crop grown in a traditional environment vs. an aquaponic environment exhibit any true difference in the rate of growth? This question was further explored by the planting of *Mentha x piperita* (common name Chocolate Mint Plant) and the planting of *Matricaria chamomilla* (common name Chamomile Tea). The primary growth (vertical growth) of the organisms were recorded over a 5-week period and compared with the growth of the same type of organisms grown traditionally in a 5-week period. The hypothesis was that growth would be much higher in the aquaponic environment versus the traditional environment due to the easier access of nutrients for the plant life, and the hypothesis was indeed confirmed, to an extent. The chocolate mint had shown stupendous growth over the short span of time but the chamomile had unfortunately died for a number of reasons. Within this project, one will find the data of the experiment, how aquaponics can be used to potentially end world hunger and allow for a larger population with less environmental damage, the methods that had been used, the results of the experiment and whether aquaponics truly is a force to be reckoned with.

Striving to Thrive Not Just Survive: Flash Freezing Yeast for Space

Annie Strange, Donny Herrera, Kelsey Hoon, Forrest Havermann, NASA Space Grant, Advisors: L Albert, B English, B Sobhani

Both humans and *Saccharomyces cerevisiae* are eukaryotic organisms, and since eukaryotic cells are not known for surviving extremely low temperatures, high altitude research provides an opportunity to explore viability using fast-growing yeast colonies to produce general hypothesis about eukaryotic cells. Gradual introduction to certain extreme conditions has been shown to increase tolerance to those conditions in yeast. The intention of this experiment is to determine if gradual exposure to extreme low-

temperatures over many generations increases yeast tolerance to low temperatures. Thus, making later generations capable of surviving in low temperature environments. From this experiment and its results, it is hoped to conclude that eukaryotic cells with gradual exposure to a certain environment can be more capable of living in those environments.

The Design and Production of a Low Cost Reliable Thermal Cyclor to conduct polymerase chain reactions

Christian Prather, NASA Space Grant, Advisor: L Albert

Here at Red Rocks Community College, student research is being done on exposing living bacterium to unfamiliar conditions. A device which allows for the amplification of DNA on returning organisms, via PCR, is needed for detailed study of induced genetic changes. Thermal cyclers are ideal, but are costly. This is why we are aiming to provide high precision, low cost thermal cyclers to students. If we are able to produce a reliable and accurate device that can be created at any makerspace for around \$100.00 we will eliminate a huge barrier to entry for those wishing to do more in the scientific field.

To solve this problem we have been researching the mechanics of current thermal cyclers and looked at other possible approaches. We have designed our own custom circuit board, using only off the shelf low cost components. All control is executed through custom code that is purposely kept as user friendly as possible in an attempt to allow for any student or individual with even basic understanding of code to follow the logic and make changes if desired. The casing was modeled in SolidWorks and ran through simulation to determine how it will open and operate. This is the final step and is designed to be made with common materials such as plywood or MDF.

Through this process we are hoping to get a reliable, easy to use device that can be made by any student for less than \$100.00. This will hopefully allow for students to gain access to industry used equipment and perform higher level scientific research. In conclusion we are shooting for a testable device by the end of the month and after initial testing we will revise design aspects to make it as accessible and open source as possible.

Effect of Nutrient-Rich Solutions on Radish Plants

Travis Funk, Sune Larsen, Tim Teska, Ryan Maruyama, BIO 111 Advisor: T Gray

The goal of our experiment is to find out which nutrient will flourish a radish plant the longest when given in a solution. We tested nitrogen, phosphorus, potassium, chlorine, salt water and tap water solutions for this experiment. All radishes were primed together and all started the same healthy size. We then transferred 3 radishes into each solution and were then started to grow in a rock base to avoid getting nutrients from soil. The solutions were made of pure or nearly pure nutrients at a ratio of 1 teaspoon per 1 cup of distilled water. All radishes were checked daily to see if they were still flourishing. The first to die were the salt water and potassium-rich solution radishes; they both were alive for 2 days. The next radishes to die were the phosphorus-rich solution and the Chlorine-rich solution at 3 days. The nitrogen-rich solution radishes lived for 9 days and the tap water radishes were still flourishing when we decided to end the experiment. The nitrogen-rich solution lived the longest out of the nutrient-rich solutions and it could be due to plants needing nitrogen the most out of all nutrients. The concentration being consistent in all the nutrients could have easily sabotaged nutrients needed far less than others.

Squashaponics

Emma Vander Woude, BIO 112 Advisor: S Kaye

Our abstract was to see which squash plant would grow better in the water beds or the lava beds. We put three of the squashes in the two areas so we can compare and contrast to see which squash would grow. We picked the Queen, the White Bush and the June squash. Our results were that the June squash grew really well in the water beds and the Queen also did really well in the lava beds.

Mag-Rail

Samantha Lemley, Mikayla Hedges, Chase Kozoh, PHY 212 Advisor: S Spivey

To build a magnetic train built for testing different magnetic strengths with vehicles made out of balsa wood. We wanted to achieve the best level of levitation with different magnetic strengths ranging in magnetic field strengths and geometrical sizes. We also wanted to come up with a propulsion system that would send our vehicle down the magnetic track.

Thursday, April 27, 1 – 3pm

Eclipse: Seeds From the Edge of Space

Kayla Andis, April Beal, Alex Langfield, Levi Lignion, Zack O'Connell, Nick Pine, Annie Strange, EGG 151 and NASA Space Grant Advisor: B Sobhani

The total solar eclipse in August 2017 is a unique opportunity to fly high altitude balloon experiments across the United States path of totality observing with cutting edge technology. The last solar eclipse visible in the western United States occurred almost a hundred years ago in 1918, and since then we've come a long way in technology. Red Rocks Community College is part of the Colorado team selected to participate in the National Eclipse Ballooning Project sponsored by NASA and Montana Space Grant. High altitude balloons will provide an excellent observation platform for the eclipse and our team has designed a payload to livestream the event from the edge of space. There are different experiments being flown by four different institutions in Colorado, with our institution, Red Rocks Community College, being one. Our particular experiment will involve the testing of plant biology when seeds are exposed to Martian-simulated conditions. Previous studies have shown that plants will grow in Martian regolith with little soil augmentation. We will be monitoring UV intensity, pressure, temperature, G-forces, and humidity. During multiple flights, we will obtain a good data comparison for seeds grown in Martian-simulated soil and earth soil. We will also have different flights to compare results, one during the solar eclipse and one without the eclipse. In order to live on Mars, humans will have to grow food and our experiment will simulate effects from seeds exposed to the harsh Martian environment. We will test the germination time, harvest yield, durability, and radiation levels of the plants grown with the exposed seeds compared to the controls. The occurrence of a total solar eclipse during this time provides unmatched opportunity to perform testing while humans are getting ready to move to Mars in the upcoming future. This project will further the development of the agricultural process on Mars.

A Study on the Mycelial Growth of *Aspergillus niger* When Exposed to Music of the 528 Hz Frequency, or “The Miracle Tone”

Sarah Kidder, BIO 111 Advisor: T Gray

Fungi have extensive value to human economy and ecology, which is why it is beneficial to understand the conditions that affect their growth rate, toxicity, antibiotic properties, or their ability to produce certain heterologous proteins. Specifically, *Aspergillus awamori* has shown to have several commercial uses, such as a probiotic that could prevent and alleviate many dietary related diseases in humans, and as an organic food processor. *A. awamori* also has the ability to host and secrete a manufactured antibody fragment (scFv) that is invaluable to medical and biotechnical communities. This ability to produce the heterologous protein was made possible by using a fusion technique that was criticized as being “laborious” and “insufficient”. A fusion technique using shock waves was developed, which proved to be much more efficient, less laborious, and more successful than the previous method. The question raised is if the frequency of the shock wave played a large role in the success of genetic recombination. More specifically, could the frequencies produced by music stimulate the replication of DNA, causing an increase of mycelial growth in *Aspergillus awamori*? A study on the effects of sound waves on mycelial growth of *Botrytis cinerea* found that a 5 kHz frequency was successful and significant inhibitor, whereas 1 kHz produced no effect. It’s most likely that stimulating frequencies may be found in the range of 0.5Hz – 900Hz. Furthermore, some research has found that a specific frequency of 528Hz was able to repair damaged DNA, though these claims have been scarcely tested. Given these inductions of current evidence linking sound and biological processes, it is hypothesized that *Aspergillus niger* (sister species to *A. awamori* that is more accessible) exposed to music in the frequency of 528Hz will exhibit more mycelial growth than those exposed to no music.

Construction of a Hypobaric Chamber for Experimental Plant Growth

Kelsey Hoon, Somair Taj, Ethan Judy, Evan Premer, Matthew Fedyk, EGG 151 Advisor: B Sobhani

To pursue the option of establishing extraterrestrial bases, the issue of implementing a reliable food source must be resolved. Space missions from Earth are costly, and launches to certain locations have limited windows of opportunity. By establishing a greenhouse, fewer resources will be required with each launch, and the space missions can be sustained for longer durations. However, due to the differences in atmospheric pressure between Earth and Mars (about 0.6% of Earth’s average at sea level), the focus of study must pertain to growing crops in lower atmospheric pressure. The team designed a hypobaric chamber, built through conservative methods, that induces an environment with lower levels of atmospheric pressure in order to test plant viability. The exterior chamber design explores the key issues of property limitations, and their manipulation under extreme conditions. Interior components have been selected with the intent of performing at nonstandard conditions.

The team modeled its research after previous NASA experiments, with their goal of maintaining plant growth at 1/16 of standard pressure conditions at Earth’s sea level. This experiment is designed to sustain half of ambient atmospheric pressure. Within these conditions, three species of plants have been selected for observation of their germination and growth rates. Final growth will be compared to a control crop, grown in standard atmospheric conditions for ~1.7 km above sea level. This study serves as a model for the conditions necessary to sustain a food source on long term space missions.

Varying Voltage in a Newman Motor

Tommy Sneller, PHY 212 Advisor: R Rahman

Our group has decided to see what effects increasing or decreasing a supply voltage would have when applied to the Newman motor design. Although the purpose of Newman's design was to gain more output than the energy supplied, the fact that he has fought the patent office and scientific community for so long has driven us to just question if his design would follow the fundamentals of physics.

We have constructed a basic Newman motor with 9v batteries (varying number), magnets, and magnetic wire to turn an axle. To determine an increase or decrease in output we have gathered rpm data from the axle showing that to a point the increase in supply will increase the output.

Microbial Growth in Winogradsky Columns Using Frozen Pond Water

Microbiology Class BIO 204 Advisor: Lynne Albert

Winogradsky columns can be used visually assess synergistic microbial growth in complex ecological systems. During January of the Spring 2017 semester, each of three microbiology sections set up Winogradsky columns using frozen pond muck and snow melt. In each Winogradsky column we included nutrients to help culture the microbes; including a sulfur source and a carbon source. Snow melt and the soil sample from the local pond contributed both a matrix for microbial growth and microbial inoculation. Each Winogradsky column was subjected to differing light conditions to assess the effect on photosynthetic microbial growth. One column was placed in direct sunlight, the second column was wrapped in green cellophane to filter out the wavelength of light used by green photosynthetic microbes, and the third column was placed in the dark. Throughout the semester, microbial stratification was observed by watching the development of green and purple bacterial growth layers in the Winogradsky column exposed to sunlight, the development of only purple-sulfur bacterial growth in the columns exposed to filtered light, and no visible bacterial stratification in the Winogradsky column left in the dark.

Effects music has on reading

Daizha Bonser, Boa Hoang, Leann Clifton, Abigail Kosciolik, Gabe Fik, BIO 111 Advisor: T Gray

We listen to music everyday while doing different activities. This study investigated the comprehension of reading while listening to different genres of music. We administered three paragraphs to 30 people, paragraph one was with no music, the second listening to a pop genre, then the third listening to screamo music. We performed the tests by timing each individual and tailing off by stutters, pausing, rereading's, and skipping. According to our results, the majority of people did not comprehend while listening to the more intense music, therefore made their time increase. So if you don't like intense music do not study with it because it will rack your mind.

Domesticated Animals and Their Effect on Bacterium Growth

Caitlin O'Donnell, Jacquelyn Ramsey, Mikalea Palmeari, Garrett Curtiss, BIO 111 Advisor: T Gray

Do dwellings with domesticated animals have an impact on the amount of bacteria that accumulates on carpet? In this experiment our purpose was to determine the effect cats and dogs have on bacteria in a residential home. Our method to test the bacterium growth was to use a sterile cotton swab to collect a sample from carpeted flooring, and then use the streaking method to isolate colonies of bacterium growth. We analyzed our data by measuring the surface area of bacterium growth on the agar dishes and

comparing the collected data of homes with and without domesticated animals. Our results show that having animals has a significant effect on the amount of bacteria that resides in carpeted flooring. Homes with cats created the greatest amount of bacteria, 85% of the surface area was covered, compared to homes with only dogs, averaging at 58%. The two control homes in this experienced averaged a mere 10% of bacterium growth on the agar dishes. Many variables that were not controlled could have led to the wide range of results such as the temperature of the homes, lighting, amount of foot traffic, and age of carpet. However, from the results of our data indicate that indeed domesticated animals will increase the amount of bacteria found in homes.

Aquaponics and Pest Controlling Plants

Samantha Ortega, Jessica Moss, Bradford Pettingill, Joel Tonkin, BIO 112 Advisor: S Kaye

Abstract: The objective of the experiment was to find out if *Citrullus lancets* grown using aquaponics were more successful being planted near *Tropaeolum minus*, a pest repelling plant, than being planted away from it. It was hypothesized that the *Citrullus lancets* that grew near *Tropaeolum minus* would have less pest activity, and would grow more successfully than the watermelon plants that were not planted near *Tropaeolum minus*. The experiment was performed by germinating both *Citrullus lancets* and *Tropaeolum minus* seeds in an organic matter aquaponics cube. Once the seeds had begun to germinate, the cubes were transplanted to an aquaponics float. Three *Citrullus lancets* sprouts were transplanted near 4 *Tropaeolum minus* plants, and 2 *Citrullus lancets* sprouts were transplanted away from the *Tropaeolum minus*. Once transplanted, the plants were left alone to grow. The *Citrullus lancets* plants were measured and observed weekly to determine the growth rate, as well as to determine if there was any insect activity that might hinder the growth of the plants. It was found upon completion of the experiment that the *Citrullus lancets* plants that were planted away from *Tropaeolum minus* had some pest activity and had more yellowing of their leaves than the plants that were planted near *Tropaeolum minus*. These results supported our hypothesis that the *Citrullus lancets* plants planted near *Tropaeolum minus* would have less pest activity and would grow more successfully.

Personality traits and the colors associated with those characteristics

Dannielle Goodwin, Meredith Winston, Sabrina Stock, Shelbie Zumwalt, BIO 111 Advisor: T Gray

This research project is based on the personality color trait test created by Dawn Billings, which groups people into 6 different personality types, each associated with a specific color. We wanted to prove how these certain colors are, in fact, associated with different personality types, so as a group, we came up with an experiment that was based off Billings's personality color trait test in order to test her color theories. We predicted that individuals who took the test would score highest in the personality type associated with their favorite color 25% more often than those who do not. As for the experiment we conducted, we distributed the personality test to a random sample of 60 people. This test consists of 42 traits that individuals can use to score themselves, based on whether they identify with those specific traits or not, and those scores are then totaled up at the bottom. Depending on which column they scored highest under, it then indicated each individual's designated personality type.

After administering all 60 tests, we collected the scoring results and then organized our data by the number of responses for each color, as well as how many people matched one of their

top two scores with their favorite color to see if we could find any trends within our data. We observed that blue was the most common favorite color, and that 76.6% of participants matched one of their top two scores to their favorite color.

Molten Salt Reactor

Jason Gray, Austin Guardiola, Jose Cespedes, PHY 111 Advisor: M Hoerner

Molten Salt Reactors (MSR's) are the future of nuclear energy. Atypical in today's society of mainly Light Water Reactors (LWR's), Boiling Water Reactors (BWR's), and Supercritical Water Reactors (SWR's), MSR's are slowly but surely being realized for their true potential despite a history of inconsistency and poor output. MSR's utilize liquid fuel instead of the conventional solid fuel rods that most of today's nuclear reactors use. Simply put, this provides a bevy of advantages while simultaneously simplifying designs and enhancing overall safety. During this semester long project, our group will be researching the physics of this alternative energy source as well as employing our knowledge of concepts learned in this course to better understand MSR's and why they are the future. Our world has a huge problem at hand, and the amount of time we take to solve this problem entirely determines the longevity of our species and all other species. That problem is widespread global pollution and its effects. One promising solution is nuclear energy. The energy needs of the world are increasing exponentially; nuclear energy provides this without the harmful effects of air pollution, yet still produces a waste byproduct that eventually finds its way into our oceans, lakes, and other fresh water sources. This creates more problems. MSR's negate the waste byproduct as you may recall they use liquid fuel. Liquid fuel means that so long as the elements needed to initiate fission are present, then other contents do not matter. Essentially, MSR's can use nuclear waste as fuel! And it's not as complex as you may think. In addition we will be creating a 3-D printed model to show just how these reactors are designed and built. Ultimately, this project seeks to inform and educate those who are interested about the limitless potential of a once discarded technology and how it can completely eliminate the need for fossil fuels, helping the Earth to combat the effects of a century of global industry.

Average Growth of Tea Plants in Aquaponics v. Traditional Environments

Fayelynn Scheideman, Ethan Larrimore, Vu Tran, Tristan Strayer, BIO 112 Advisor: S Kaye

Runoff. Pollution. Eutrophication. False phosphates. Pesticides. Wasted water. Traditional agriculture does nothing but decimate these lands. There must be another way, one that replicates nature in itself: aquaponics. This natural process allows for crop to be grown without the potential environmental destruction caused by runoff of farmer-added nutrients and allows for the crop to be grown with up to 90% less water than it would require for traditional agriculture. This is all magnificent from the start, but what about the rate of growth? Could the same type of crop grown in a traditional environment vs. an aquaponic environment exhibit any true difference in the rate of growth? This question was further explored by the planting of *Mentha x piperita* (common name Chocolate Mint Plant) and the planting of *Matricaria chamomilla* (common name Chamomile Tea). The primary growth (vertical growth) of the organisms were recorded over a 5-week period and compared with the growth of the same type of organisms grown traditionally in a 5-week period. The hypothesis was that growth would be much higher in the aquaponic environment versus the traditional environment due to the easier access of nutrients for the plant life, and the hypothesis was indeed confirmed, to an extent. The chocolate mint had shown stupendous growth over the short span of time but the chamomile had unfortunately died for a number of reasons. Within this project, one will find the data of the experiment, how aquaponics can be used to potentially end world hunger and allow for a larger population with less environmental damage, the

methods that had been used, the results of the experiment and whether aquaponics truly is a force to be reckoned with.

Power from the Ocean

Nathan Ernst, Sam Henderson, Donny Herrera, James Cook, PHY 111 Advisor: M Hoerner

The ocean is full of potential energy. With a coastal Tidal Wind Turbine, we can harness that potential to power our cities and our way of life with a green alternative to fossil fuels. Tidal wind turbines harness not only the power of the wind but the tides of the ocean itself to convert into clean, green, renewable energy. With our project, we will explore the potential benefits of this largely untapped energy source and look at its potential to help alleviate some of our nation's dependence on fossil fuels.

Converting the kinetic energy of the tides and the force of the wind to turn the turbines and produce electricity for home and commercial consumption is a great example of physics and theory in action to improve daily life. Wind turbines are not a new technology but with recent innovations in construction techniques and revolutionary designs the efficiency of this old technology can be greatly improved. Our scale built model will show an example of the efficient designs that are being created by innovative designers all over the world.

While tidal wind turbines are not without their challenges we feel that the potential benefits of this energy source far outweigh the negatives. Innovative designers are constantly thinking of new ways to reduce the impact on local ecologies and human communities alike. Initial cost may be high for this new technology but the long-term gain is worth it.

The potential is there to produce a significant portion of our renewable energy goals from tidal wind turbines if we use it. While tidal wind turbines won't be enough to solve the problem of fossil fuels all by itself it can and should be a piece of the solution.

Wind Turbines

Kelly Binns, Ariel Cain, Bethany Distel, Ramon Sasse, PHY 111 Advisor: M Hoerner

When discussing potential energy resources, we are searching for the most effective and practical option when it comes to providing energy for our ever-growing population in the future. Wind is one of the many sources of energy we chose to investigate. Understanding the physics behind wind turbines helps to better manufacture the best possible materials for the most efficient transfer of kinetic energy to mechanical energy. More specifically, we delved into how Newton's Laws of Motion and Rotational Motion are related to the utilization of wind energy, as well as how to construct a mechanism to convert this energy into something we can use in our everyday lives. Materials used in construction of the turbines is vital to the overall efficiency of using wind technology as a renewable energy source, the blades on the turbine cannot be so heavy as to be immovable by the wind because the turbine would cease to spin and therefore have no energy output; however, the blades cannot be too light due to fact that this could cause the rotor to burn out resulting in no transfer of energy. The effort and materials put towards wind technology are quite expensive and therefore companies specializing in wind energy would need to generate enough profit to break even as well as purchase new capital. One of the biggest limitations that wind technology faces is the matter of location, specifically finding "the perfect site," this includes wide open spaces with next to no obstructions. In conclusion, our intention is to investigate and further expand on the possible efficient real life applications of wind turbines as a prime renewable energy source.

Survival of the Fittest

Misty Hughes-Aletheuo, Gabrielle Wenger, Kianna Fischer, Christine Roper BIO 112 Advisor: S Kaye

The purpose of our experiment is to determine how effective aquaponics is when growing plants from three distinct biomes. The use of an aquaponics system eliminates the usage of soil by returning nutrients to the plants by way of fish fecal matter through water distribution. To test the effectiveness of the aquaponics system we chose to compare mesophytic, xerophytic, and hydrophytic plants to observe whether specific plants out compete others in an aquatic environment. The plants utilized in our experiment were *Origanum vulgare*, *Mimosa pudica*, and *Typha*. We hypothesized that the typha (cattail) would grow best out of the three in the aquaponics system due to the wet environment. In summary, our hypothesis was proven incorrect. The presence of black algae had significant effects on *Typha* and *Origanum vulgare* making the *Mimosa pudica* best suited for the aquaponics system.

Exploring the Physics of Natural Steam Systems

Tiffany Jaramillo, Laci Hageman, Chris Masterson, PHY 111 Advisor: M Hoerner

Geothermal natural steam systems use heat radiating from the center of earth from water and rock to generate steam. As the geological heat moves upward to the earth's surface, it heats the different layers of earth that it must pass through and provides an efficient and cost effective form of geothermal energy. To gain a better understanding of this energy our group has constructed a 3D model and poster of the system that allows viewers with no Physics background to visually understand the concept, process and flow of energy.

Utilizing this form of energy is important not only because it is more cost efficient than other forms of renewable energy but also because it allows us to manipulate the energy that is readily available and does minimal damage to the environment around us. The Physics behind natural steam systems uses thermodynamics and convection to harness geothermal energy. A natural steam system takes hot water from the earth and converts it to steam. The steam passes through a turbine making it spin as the steam condenses back into water and is replaced into the earth. The spinning turbine is connected to an electrical generator which takes the movement of the turbine and generates electricity. Thermodynamics is described as the flow of energy in the form of heat which is used in every step of the natural steam system. Convection plays an important role as well. Hot fluids rise and colder, denser fluids sink. The movement of the fluids results in another transfer of heat. Converting to a system less damaging like natural steam systems is a great option to keep life as is and simultaneously protect the earth.

Can Hybrids and Electric Vehicles Dethrone Fossil Fuel Engines?

Evan Glovan, Nastassja Michel, Nikki Kovac, PHY 111 Advisor: M Hoerner

Hybrid and Electric cars are becoming more widely used worldwide. We will be examining the reasons behind the growing popularity and explaining how each system works, as well as the physics used in their operation and if the technology is viable for long term use.

Electric and hybrid cars work in different ways compared to internal combustion engines. Electric engines use very different engines, some of them only having a single moving part. Hybrid cars use a combination of the two systems to work. We will explain how each engine system is different, including variations of the hybrid and electric systems. This will include hybrids such as the Toyota Prius and electric cars such as the Tesla. We will also look at how electric systems are used in motorsport for horsepower alongside efficiency. Next, we plan to examine the physics properties used to make electric motors work. The first is the friction produced by electric motors compared to combustion engines, including concepts like

regenerative braking to reduce wasted energy; the second being the torque produced by electric cars compared to combustion engines. We also examine the global politics surrounding electric/hybrid vehicles and the effects they have had on the world. Using this information, we examine whether the hybrid and electric system is viable for future investment and how the true cost varies by location. We will also have a physical representation of hybrid and electric cars to accompany our research.

The recent innovations in electric motors are astounding, as is how these technologies are used in electric and hybrid motor systems. More electric and hybrid cars are being purchased worldwide than ever before. This is reducing the world's dependency on fossil fuels and therefore, the global emissions impacting our environment.

Nevado Del Ruiz

Jean Anselmi, Erin Stockmyer, Daisy Bonilla, Aisha Ozaslan, ENV 110 Advisor: L Hoerner

Nevado Del Ruiz – The disaster that should never have happened.

Our group did a case study of the Nevado Del Ruiz volcano in Columbia, specifically the disaster it caused in 1985. We explored the history of the volcano and its negative effects, analyzed what was done well and could have been done better in the past, what the news and media coverage were like at the time of this specific disaster, what lessons we learned, and how humans/the changing environment are affecting this hazard. Our methods were looking at a variety of sources about what happened and drawing on our knowledge of geological hazards from our Natural Disasters course. We found that the disaster which happened in 1985 was completely preventable. There was a period of hours between the small eruption which started the mudflows and when those flows reached the town of Armero, the most heavily impacted and close to eradicated place affected. There was plenty of time to evacuate the entire town, yet due to a failure of authoritative communication the town was not evacuated. We concluded that this disaster was completely preventable, and that action needs to be taken in the future to keep history from repeating itself.

National Water Quality Lab Internship Presentation

Andy Cross, Internship

This poster presentation is going to be part of my internship at the National Water Quality Lab. I will be talking about some of the tests we do for samples that come to the nutrients department for analysis. Much of the poster is going to be a general overview of the different labs in the nutrients department. I typically work in one of two labs (residue on evaporation/ suspended solids and a lab that uses a discrete analyzer) so these will be highlighted more so than other labs in the department. I prepare some of the machines in the other labs as well, but am less familiar with them and plan to include them in a more general discussion about the lab as a whole.

Effects of Varied Germination Methods on Growth in *Pisum sativum* and *Phaseolus vulgaris*

Caitlin Ayres, Christopher Mason, Eric Shulte, Maya Delauro, BIO 112 Advisor: S Kaye

A seed is revived from dormancy by the process of germination to begin its life as a plant. This experiment set out to demonstrate the effects of varying the germination method of pea plants prior to their

transplantation into an aquaponics system. In an aquaponics system, tilapia fish are living in the tank which supplies the water to sustain the plants, also providing bacteria to breakdown nitrites into nitrates and further fuel the plants with nutrition. Peas typically grow well in these conditions. The experiment proposed the question of what germination methods would produced the tallest plants with the most pod production providing a resource for future sustainability.

The variables of the experiment included the method of germination, the species of pea plant, and the aquaponics growing medium. The germination setup is to support the seed as it sprouts and the method utilized were rockwool, cotton balls, paper towels, and gauze. The species of plants used were *Pisum sativum* and *Phaseolus vulgaris*. The aquaponics systems used were a flood and drain medium and a flotation medium.

Once germinated, the plants were relocated to their aquaponics system and measured weekly for primary growth. The experiment is not yet concluded but thus far the results depict the most successful plant growth of a *Phaseolus vulgaris* growing from rockwool in the flood and drain system. Measurements conclude next week and further analyzation and conclusions will follow.

Railgun Experiment

Kyle Yamek, Skyler McMullen, Drake Bailey, Nick Navarro PHY 212 Advisor: R. Rahman

Electricity and Magnetism coexist in the natural world and share an interdependent relationship. Electromagnetism behaves by deforming the space around it, and the consequences of this can be exploited to manipulate susceptible objects. In 1918, French inventor Louis Octave Fauchon Villeplee invented the Electric Canon (an early form of the modern rail gun), since then scientists and engineers have been refining the general concept. Generally, an electromagnetic projectile launcher consists of two parallely aligned conductive rods and a conductive projectile (referred to as the armature), which closes the circuit between the two wires. The armature is free to move linearly in between the two rods. This design enables the exploitation of the Lorentz Force on the now conducting armature. Our goal is to effectively redesign the Electric Canon. Our area of focus is the energy of our system, in that it is our expectation that there will be a high level of it. Our challenge is to take this assumption and use it to our advantage. The contact points on the armature. Limiting the time period in which current is flowing through the armature will prevent the projectile from fusing to the rails, however it will minimize the duration of the Lorentz force on the armature. Consequently, we will attempt to optimize the time the armature is between the two rails, and this will limit any melting of the material and maximize the acceleration of the projectile.

Effects of caffeine

Sami Damm, Carly Andres, Lauren Thaut, Taylor Gillmor

Question- How does caffeine affect one's cognitive abilities and blood pressure? Hypothesis- That 12oz of coffee would effect ones mental capabilities and blood pressure scores overall by 10%.

Experiment Summary- To test the cognitive ability we would test them with the Dual n-back cognition test stimulates the hearing abilities as well as visual. We split up in the group to test people because only two of us knew how to take blood pressure, so the other two of us administrated the cognitive test. In both tests, we tested the subject before having them drink coffee. Since it take 15 minutes for the effects of caffeine to kick in we would also test them 15 minutes after they drank coffee.

Thanks to all the students and faculty that participated in the Science Expo this year!

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